STROPHOCINCLA LAUGHINGTHRUSHES OF SOUTH INDIA: A CASE FOR ALLOPATRIC SPECIATION AND IMPACT ON THEIR CONSERVATION

PRAVEEN J.[1] AND P.O. NAMEER[2]

[1]B303, Shriram Spurthi, ITPL Main Road, Brookefields, Bengaluru 560 037, Karnataka, India. Email: paintedstork@gmail.com
[2]Department of Wildlife Sciences, College of Forestry, Kerala Agricultural University, Thrissur 680 656, Kerala, India.
Email: nameerpo@gmail.com

The Western Ghats of southern India are home to four endemic laughingthrush taxa belonging to genus *Strophocincla*, currently lumped as two species, namely Black-chinned Laughingthrush *Strophocincla cachinnans* and Kerala Laughingthrush *Strophocincla fairbanki* – each of them with two races, namely *jerdoni* and *cachinnans* for the Black-chinned, and *fairbanki* and *meridionale* for the Kerala Laughingthrush. All of them inhabit montane ecosystems exclusively above *c*. 1,200 m and have been of great interest for speciation studies as they are strictly allopatric as their ranges are separated by valleys with unsuitable altitudes. This paper describes the morphological and geographical differences between these four races and proposes a case for considering each of them as an independent species based on the 'quantitative criteria for species delimitation' method. Based on this methodology, the forms *jerdoni* and *meridionale* were found to differ from *cachinnans* and *fairbanki* respectively, by scores sufficient to be ascribed a full species status. In the wake of this status change, the IUCN Red List criteria were applied to all four taxa and *S. jerdoni* was evaluated as Critically Endangered and *S. meridionale* as Endangered. This new found threat level is expected to catch the attention of forest departments and policy makers to advocate specific conservation actions to arrest the decline.

Key words: Laughingthrush, speciation, IUCN Red List, Western Ghats

INTRODUCTION

The Western Ghats of southern India are home to four endemic laughingthrush species belonging to genus *Strophocincla*, currently lumped as two species, namely Black-chinned Laughingthrush *S. cachinnans* and Kerala Laughingthrush *S. fairbanki* – each of them with two races namely *jerdoni* and *cachinnans* for the Black-chinned, and *fairbanki* and *meridionale* for the Kerala Laughingthrush (del Hoyo *et al.* 2007; Rasmussen and Anderton 2005). All of them inhabit montane ecosystems above *c*. 1,200 m and have been of great interest for speciation studies as they are strictly allopatric, their ranges being separated by valleys with unsuitable altitudes. The only other laughingthrush found in southern India is the monotypic Wayanad Laughingthrush *Dryonastes delesserti*, which is unrelated to the *Strophocincla* Laughingthrushes and inhabits low and mid-altitude forests of the Western Ghats (Sashikumar *et al.* 2011).

Taxonomic History – Splits and Lumps

FAUNA OF BRITISH INDIA (Oates and Blanford 1889), henceforth referred to as the OLD FAUNA, the first comprehensive treatise on Indian birds, included all the four forms of Laughingthrushes as individual species under the genus *Trochalopteron*. *T. cachinnans* was described from the Nilgiris as *Crateropus cachinnans* (Jerdon 1839) and it was later placed under *Garrulax* and then *Pterocyclus* before it settled under *Trochalopteron* in the OLD FAUNA. *T. jerdoni* collected from the Banasore (=Banasura) peak was described as *G. jerdoni* (Blyth 1851) but moved later to *Trochalopteron* in the OLD FAUNA. *T. fairbanki* was described from Palani Hills (Blanford 1869) and *T. meridionale* from south Travancore (Blanford 1880). Apart from these four forms, the OLD FAUNA also described a fifth from South India, *T. cinnamomeum*, from an unknown type locality (Davison 1886). This race has not been traced since then and recent ornithological works do not recognise this form (Rasmussen and Anderton 2005).

Baker (1927), henceforth referred to as the NEW FAUNA, adopted all five forms described in the OLD FAUNA – but did a small but important lumping. Baker (1927) treated *T. fairbanki* and *T. meridionale* as subspecies of *T. jerdoni* based on the 'grey breast' all three share. *T. cinnamomeum* was treated as a subspecies of *T. cachinnans* based on its rufous breast. This classification stood for nearly 80 years – except that all the forms were moved under *Garrulax* (Ali and Ripley 1987), which most field guides since then followed (Grimmett *et al.* 1999; Kazmierczak 2000). Rasmussen and Anderton (2005) finally revoked this lumping. They made a logical, though partial, move of lumping *G. j. jerdoni* with *G. cachinnans*, as they are endemic to the Ghats north of Palakkad (=Palghat) gap, an ancient divide responsible for speciation in the Western Ghats (Ali 1969). This also means that the *fairbanki* form returns to its species status with *meridionale* as its subspecies, both forms restricted strictly south of the Palakkad gap. They also reinstated the old genus name of *Trochalopteron* instead of *Garrulax* though the genus was changed again recently to *Strophocincla* (del Hoyo *et al.* 2007). We base our work on this taxonomy and discuss the validity of all the subspecies.

Distribution

All four *Strophocincla* Laughingthrushes are allopatric (Fig. 1). Form *jerdoni* is found in the hills of Coorg and Wayanad while *cachinnans* is mostly concentrated around Nilgiris with a vestigial population in Muthikulam hills lying immediately north of the Palakkad gap. Form *fairbanki* occurs in Nelliampathy hills immediately south of the Palakkad gap, mostly along Munnar-Kodaikanal hills and further south in High Wavies-Pandalam Hills until Shengottah (=Achenkovil) gap. Area south of Shengottah gap, known as Agasthyamalai hills, is the home of the *meridionale* form (Sashikumar *et al.* 2011). Details of the distribution are summarised in Table 1.

Objective

This paper describes the morphological and geographical differences between these four races and proposes a case for assigning species status based on 'quantitative criteria for species delimitation', a method described by Tobias *et al.* 2010. If this be the case, the current threatened status of these birds would also require re-evaluation and the same is also discussed.

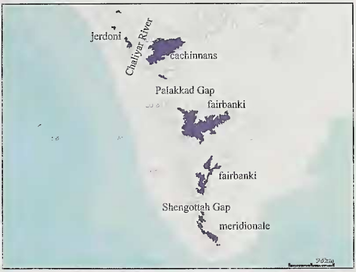

Fig. 1: *Strophocincla* distribution map

METHODOLOGY

Biological Species Concept (BSC) is still the most widely followed yardstick for designating bird species (Haffer 2007). However, evaluation of allopatric species inhabiting islands or continental islands is still a 'grey area' and mostly based on inference, on the degree of difference between two related sympatric species (Haffer 2007). Speciation rules of British Ornithological Union (BOU) are also framed using this concept "the level of divergence is equivalent to that found in related sympatric species" (Helbig *et al.* 2002). The concept of a 'species' may not be important to understand evolution or speciation (Tobias *et al.* 2010). However, this is a unit treated by conservationists and policy makers for formulating national and international law, and hence a consistent and transparent process should be followed in evaluating the same.

Table 1: Distribution of *Strophocincla* laughingthrushes of southern India

	S. jerdoni	*S. cachinnans*	*S. fairbanki*	*S. meridionale*
Range	Coorg & Wayanad Hills	Nilgiri & Muthikulam Hills	Anamalais, High Wavies & Pandalam Hills	Agasthyamalai Hills
Southern Limit	Chaliyar Valley	Palakkad Gap	Achenkovil Gap	None
Extent of Occurence	<100 sq. km	<1,500 sq. km	<2,000 sq. km	<300 sq. km
Area of Occupancy	Unknown	<250 sq. km	Unknown	Unknown
No of locations	3	3	7	5
Protected Areas (PAs)	Brahmagiri WLS, Aralam WLS	Mukurthi NP, Silent Valley NP	Indira Gandhi WLS, Chinnar WLS, Eravikulam NP, Anamudi Shola NP, Pampadum Shola NP, Mathikettan Shola NP, Kurinjimala WLS, Periyar TR	Shendurney WLS, Peppara WLS, Neyyar WLS, Kalakad-Mundanthurai TR, Kanyakumari WLS
Largest Population	Vellarimala-Chembra, Wayanad district	Nilgiris	Grass Hills-Eravikulam	Kalakad-Mundanthurai TR, Tirunelveli district
Extent of Occurence under PA Network	<15 sq. km	<100 sq. km	<200 sq. km	<275 sq. km
Current Status	EN	EN	NT	NT
States	Kerala, Karnataka	Kerala, Tamil Nadu	Kerala, Tamil Nadu	Kerala, Tamil Nadu

With this in mind, Tobias *et al.* (2010) framed a process based on a scoring system, and showed that their system performed with a high degree of consistency in evaluating known, well-accepted species and races. For a detailed description of the method the reader is directed to the original work; however, some clauses and assumptions made in that work are re-emphasised here.

Tobias *et al.* (2010) list a process which provides integral scores to the consistent differentiating bionomical, morphological, and acoustical features between two taxa. It is important to recognise that their method does not require molecular level differences though it is indicated as future work. To ensure that one single trait does not overwhelm the evaluation, at most two acoustical characters or two bionomical characters or three morphological characters can be considered in scoring. A total score of 7 or above is considered to be good for a species and statistically this number holds good for a large number of recognised species and subspecies. This method was also followed to evaluate Asian babblers (Collar 2006) and the recommendations made in that paper have been well accepted by the international community (Rasmussen and Anderton 2005). Of specific interest is the evaluation of allopatric races of two laughingthrush super-species from South Asia (Collar 2006) using this method. Bhutan Laughingthrush *S. imbricatum* was split from Streaked Laughingthrush *S. lineatum* and are allopatric despite close geographical approach. Similarly, the two south Asian taxa which were part of Chestnut-crowned Laughingthrush complex – Red-headed Laughingthrush *T. erythrocephalum* and Assam Laughingthrush *T. chrysopterum* – were split from each other (Rasmussen and Anderton 2005) while the extralimital Southeast Asian groups were split as Malayan Laughingthrush *T. peninsulae*, Golden-winged Laughingthrush *T. ngoclinhensis* and Silver-eared Laughingthrush *T. melanostigma* (Collar 2006). All five new species recognised thus are allopatric.

In this paper, we work with morphological characters (an upper limit of only three characters), which are described in well-known literature and hence there is no original data to be reviewed or vetted before this scoring can be used. In this new light, all the four taxa are re-evaluated using the IUCN Red List Categories and Criteria (IUCN Standards and Petitions Subcommittee, 2010) based on the thresholds of Extent of Occurrence (EOO) and Area of Occupancy (AOO) (Table 2), and their revised threat level established. This process banks heavily on data collected from the field through focused bird surveys undertaken by the authors and their associates in different parts of Western Ghats (Praveen and Nameer 2009). Based on these surveys, the EOO, defined as the shortest boundary drawn to encompass all the known, inferred, and projected sites of occurrence, excluding large areas of unsuitable habitats, and the AOO, defined as the area within its EOO which is occupied by the taxon, are calculated.

Table 2: IUCN thresholds for EOO and AOO

Category	EOO Threshold	AOO Threshold
Critically Endangered	100 sq. km	10 sq. km
Endangered	5,000 sq. km	500 sq. km
Vulnerable	20,000 sq. km	2,000 sq. km

RESULTS AND DISCUSSION

Table 3 describes the scoring for *S. jerdoni* (Fig. 2) with respect to *S. cachinnans* (Fig. 3), and Table 4 for *S. meridionale* (Fig. 5) with respect to *S. fairbanki* (Fig. 4). As can be seen from the result – both scores are good enough to be considered as full species purely based on morphological differences. Remarks column indicate the rationale for the scores and these are based on the guidelines of Tobias *et al.* (2010).

Speciation rules of BOU or Helbig *et al.* (2002), which compare the divergence against similar sympatric species, are less suited for our study as all the *Strophocincla* laughingthrushes in the world are allopatric. Sympatric laughingthrushes from other genera are fairly distinct in plumage and size, and do not appear to be good candidates for this level of comparison. Hence, the method we used is probably the only way to evaluate these four taxa within the purview of BSC.

However, the pre-application of this theory to the two laughingthrush groups by Collar (2006) enables us to compare our scores with these accepted species. It is important to note that the 'upper limit rule' of at most three morphological characters has not been followed in Collar (2006), and hence the published scores are higher than they should have been if based on the final species delimitation rules.

Without vocalisations, which are pending further study (Rasmussen and Anderton 2005), Bhutan Laughingthrush

Table 3: Scoring for *S. jerdoni* vs. *S. cachinnans*

Differences	Score	Remarks
Pale grey upper breast vs. Orange-rufous upper breast	4	Radically different colour to a significant plumage area
Grey ear coverts vs. Pale rufous ear-coverts	3	Entirely different colour to a part of the head
Sum of top 3 scores	7	

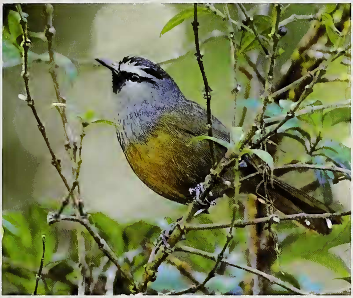

Fig. 2: Banasura Laughingthrush *S. jerdoni*

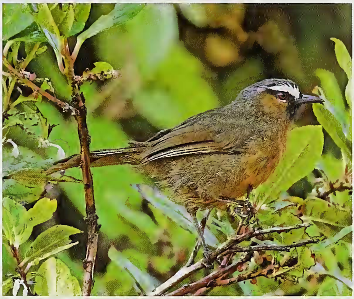

Fig. 3: Nilgiri Laughingthrush *S. cachinnans*

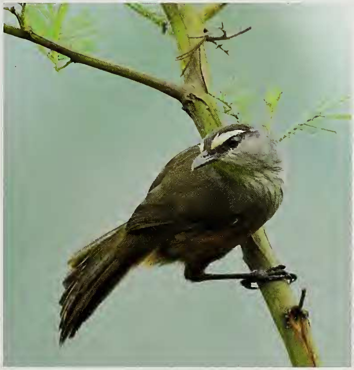

Fig. 4: Palani Laughingthrush *S. fairbanki*

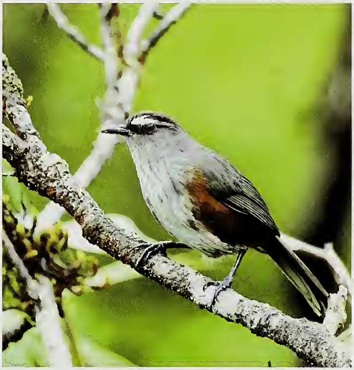

Fig. 5: Travancore Laughingthrush *S. meridionale*

would score 6 on morphology with an additional single on biometrics, which makes it a full species with score 7. However, there are no striking differences (like rufous vs. grey) in its morphological differences with Streaked Laughingthrushes and still it qualifies as a full species.

The situation of Chestnut-crowned Laughingthrush is more interesting. On applying the 'upper-limit rule', the Malayan Laughingthrush would only score 5 (suggested 9 without upper-limit rule) on morphology, and their vocal and mensural differences are unknown. Gold-headed Laughingthrush would just scrape through with a 7 (in fact 6-7, suggested 7-8) while Silver-eared Laughingthrush would only score 4 on morphology with a perceived significant difference (score of 3) in its vocalisation of this taxa with that of *woodi* race of Red-headed Laughingthrush, which is the nearest geographical cousin. In every respect, the differentiation of *S. jerdoni* and *S. meridionale* forms is much stronger than these accepted species.

In this context, it may be worthwhile to mention the other two traits. Mensural traits of each of the races are given in the classical references. However, they cannot be used for this analysis as the raw data is not available for calculating the variance. Min-max values were overlapping and the nominate forms seem to have a greater min-max variation.

This could be attributed to the lack of sufficient sample size for the other two 'rarer' races. None of the available literature mentions an observable difference of size in any of the body parts. Hence, if indeed there is a mensural difference, the scores might not be sufficiently high to aid a positive delimitation.

Similarly, there are no prior studies on the acoustical differences between the taxa. At the time of writing, preliminary surveys to document the calls are underway and should hopefully provide more insights into any differentiation at this level. Tobias *et al.* (2010) observed that there is a strong negative correlation between the scores of morphological traits and acoustical traits – hence, it would not be surprising if the experiment determines that there is no statistically significant acoustic differentiation.

The last frontier for speciation studies is at the molecular level. This would provide an insight on how genetically divergent each of the populations is. Similar works in other species (Robin *et al.* 2010) have found out that ancient gaps in hill ranges have shaped speciation in the birds of the Western Ghats. Hence, this hypothesis should also be tested with molecular samples to determine the genetic divergence of these taxa.

Naming

It is probably inappropriate to suggest new names for the four taxa studied here and it is strongly felt that the original names proposed by the 19th century ornithologists should be reinstated (see Table 5).

Conservation

As the motive for reassessing these species limits has been for conservation, it is worth revising the threatened status of all the four races against IUCN criteria according to their current status (Table 1).

The available information for all four species is similar. EOO for all four species is well-defined while information on AOO is meagre with the possible exception of Nilgiri Laughingthrush (Zarri *et al.* 2008). There is a wealth of data on the range fragmentation and sub-populations. Risks like habitat loss, loss of habitat quality and habitat transformation are present for all the species in varying degrees. Areas that fall within PA network are also known, which helps to estimate the likelihood of assessed risks. Based on this information, the following is proposed for each species.

Table 4: Scoring for *S. meridionale* vs. *S. fairbanki*

Character	Score	Remarks
Prominent dark streaks on breast vs. Very weak stripes on breast	3	Entirely different pattern
White centre of belly vs. Solid rufous-chestnut belly	3	Entirely different colour to a part of the body
Greyer upperparts vs. Medium brown upperparts	2	Different tone
Shorter white supercilium vs. Long white supercilium	1	Distinctly different pattern
Pale brown crown vs. Dark brown crown	1	Slightly different wash
Sum of top 3 scores	8	

Banasura Laughingthrush: The species (Fig. 2) has a small geographical range characterised by an EOO less than 100 sq. km threshold (actual < 57 sq. km), which in itself is severely fragmented and continues to decline due to loss of habitat and the same is feared to have gone locally extinct in a few locations. Hence, it qualifies as Critically Endangered under B1abiv (IUCN 2011). The supporting data is as follows:

1. Recent surveys (post 2005) have recorded this species only in Vellarimala, Chembra, and Banasura, all in Wayanad district of Kerala and Ambalapara-Brahmagiris along the Karnataka-Kerala border. With the exception of Brahmagiris, the bird has been partial to altitudes above 1,600 msl.

2. Past reports during expeditions by other birdwatchers include sightings from Pushpagiri Wildlife Sanctuary (WLS) (1997), Kudremukh National Park (NP) (2001), Bababudan Hills (2002), all in Karnataka and Kurichyarmala (1998) in Kerala, all sites having a likely altitude and similar habitat to support this species. However, the bird has not been recorded from these sites post-2005, despite surveys with specific focus on high altitude endemics – indicating a continuing decline in the number of locations. It should be noted that even if we include the habitats in all these sites, the EOO is just 90 sq. km, sufficiently below the CR threshold.

3. Vellarimala (29.39 sq. km) and Chembra (7.46 sq. km) regions are likely to be connected populations as both are part of a high plateau (1,400 msl), while Banasura (4.63 sq. km) and Brahmagiris (14.83 sq. km) are disjunct. Hence, the population is severely fragmented into three sub-populations with potentially the largest occurring in Vellarimala-Chembra. Except for Brahmagiris, all other regions fall outside the PA network.

Nilgiri Laughingthrush: This species (Fig. 3) has a small geographical range characterised by an EOO less than 5,000 sq. km threshold (actual <1,500 sq. km) and an AOO less than 500 sq. km threshold (actual <250 sq. km), and this range is severely fragmented and continues to decline due to loss of habitat quality. Hence, it qualifies as Endangered under criteria B1abiii and B2abiii (IUCN 2011). This species was already listed as Endangered prior to the taxonomic merger with *S. jerdoni*. The supporting data is as follows:

1. Based on studies in the Nilgiris (Zarri *et al.* 2008), AOO is estimated as 210 sq. km, and even if the EOO of Muthikulam population (25 sq. km) is included, it is well short of the AOO threshold for Endangered. The species occupies altitudes above 1,600 msl and possibly down till 1,400 msl for dispersal. Total area above 1,400 msl in its range (same as EOO) is below 1,500 sq. km: 1,454 sq. km in Nilgiris and 25 sq. km in Muthikulam.

2. Studies in the Nilgiris (Zarri *et al.* 2008) indicate that the population survives in small sholas, which are extremely fragmented, and suffers serious habitat loss due to conversion of sholas for other purposes like roads, buildings, plantations, etc.

Palani Laughingthrush: This species (Fig. 4) has a small geographical range characterised by an EOO less than 5,000 sq. km threshold (actual <2,000 sq. km) and occurs in not more than five locations. However, there is no observed, inferred, or projected evidence of continuing decline in any of the parameters. Since the species almost meets Endangered criteria B1ab, it may be treated as Near Threatened. This species was listed at the same level till date, irrespective of taxonomic revisions. Any information on continuing decline in the future may warrant uplisting.

Travancore Laughingthrush: This species (Fig. 5) has a small geographical range characterised by an EOO less than 5,000 sq. km threshold (actual <304 sq. km), which in itself is severely fragmented and continues to decline due to loss of habitat quality. Since AOO is a part of EOO which is 304 sq. km, AOO is also less than 500 sq. km. Hence, it qualifies as Endangered under criteria B1abiii and B2abiii (IUCN 2011). Supporting data is as follows:

1. Recent surveys have recorded it mainly from Kalakkad-Mundanthurai Tiger Reserve (KMTR) and adjoining Neyyar-Peppara WLS, apart from Pandimotta and Vairattimotta areas in Shendurney WLS and Mahendragiri in Kanyakumari WLS. In all regions, the species occurs clearly above 1,200 msl. Total EOO of this population is only 304 sq. km. and spread across the four locations, the largest being KMTR region (230 sq. km) and three smaller blocks like Vairattimotta (14.75 sq. km), Pandimotta (56.14 sq. km), and Mahendragiri (3.55 sq. km).

Table 5: Common Names for *Strophocincla* laughingthrushes

Common Name	Scientific Name
Banasura Laughingthrush	*Strophocincla jerdoni*
Nilgiri Laughingthrush	*Strophocincla cachinnans*
Palani Laughingthrush	*Strophocincla fairbanki*
Travancore Laughingthrush	*Strophocincla meridionale*

2. Recent studies have found that the density of breeding territories of this taxon is negatively correlated to the density of *Ochlandra* reeds in the territory. Montane forests in these hills have been replaced in several parts by brakes of *Ochlandra*, probably after clear felling and forest fires wiped out the natural vegetation. The transition in habitat is believed to be a recent phenomenon and there is a potential threat from forest fires (Vivek Chandran *in litt.*), and habitat quality is thus being affected.

Based on this new information, great emphasis should be given to the conservation of *S. jerdoni* and *S. meridionale* – both taxa which were subsumed under more widespread nominates, and hence had not received the attention of policy makers.

CONCLUSION

It is expected that the possibility of *S. jerdoni* and *S. meridionale* being raised to full biological species will bring additional attention from the concerned forest departments and montane areas of conservation significance will be demarcated as protected areas to control the continuing decline in these habitats. On the global scale, application of the scoring based species delimitation would enable reassessment of several similar allopatric biological species, which have not received conservation attention from policy makers.

ACKNOWLEDGEMENTS

We thank Dr. Nigel Collar, Birdlife International, for commenting on an earlier draft and Dr. Asad Rahmani, BNHS, for supporting this theory. Dr. Pamela Rasmussen, Chair of the Session, kindly offered her thoughts on this theory. We thank Sandeep Das and Vivek Chandran for the photographs of the four races. Much of the conservation data on the Travancore Laughingthrush has been collected by Vivek Chandran, who shared it with us prior to his own publication.

REFERENCES

Ali, S. (1969): Birds of Kerala. Oxford University Press, Bombay. Pp. 328–330.

Ali, S. & S.D. Ripley (1987): Handbook of the Birds of India and Pakistan. Vol. 7: Laughing Thrushes to Mangrove Whistler. Pp. 40–44.

Baker, E.C.S. (1927): The Fauna of British India, including Ceylon and Burma. Birds. Volume 1. Taylor and Francis, London. Pp. 176–179.

Blanford, W.T. (1869): Ornithological notes, chiefly on some birds of central, western and southern India. *J. Asiatic Society Bengal XXXVIII(2)*: 164–191.

Blanford, W.T. (1880): On a species of *Trochalopterum* from Travancore. *J. Asiatic Society Bengal XLIX (Part II, No. III)*: 142–144.

Blyth, E. (1851): Notice of a collection of Mammalia, birds, and reptiles, procured at or near the station of Chérra Punji in the Khásia Hills, north of Sylhet. *J. Asiatic Society Bengal XX (Part II, No. 4)*: 517–524.

Collar, N.J. (2006): A partial revision of the Asian babblers (Timaliidae). *Forktail* 22: 85–112.

Davison, W. (1886): ["I have just returned from a trip to Southern Travancore,..."]. *Ibis (5)4*: 203–205.

del Hoyo, J., A. Elliott & D.A. Chris (2007): Handbook of the Birds of the World. Vol. 13, Lynx Edicions, Barcelona. Pp. 70–292.

Grimmett, R., T. Inskipp & C. Inskipp (1999): Pocket Guide to the Birds of the Indian Subcontinent. Oxford University Press, New Delhi. Pp. 302.

Haffer, J. (2007): Species Concepts and Species Limits in Ornithology. Foreword *In*: del Hoyo, J., A. Elliott & D.A. Chris (2007): Handbook of the Birds of the World. Vol. 13, Lynx Edicions, Barcelona. Pp. 11–24.

Helbig, A.J., A.G. Knox, D.T. Parkin, G. Sangster & M. Collinson (2002): Guidelines for assigning species rank. *Ibis 144*: 518–525.

IUCN (2011): The IUCN Red List of Threatened Species. Version 2011.2. <http://www.iucnredlist.org>. Downloaded on November 10, 2011.

IUCN Standards and Petitions Subcommittee (2010): Guidelines for Using the IUCN Red List Categories and Criteria. Version 8.1. Prepared by the Standards and Petitions Subcommittee in March 2010. <http://intranet.iucn.org> Downloaded on November 10, 2011.

Jerdon, T.C. (1839): Catalogue of the birds of the peninsula of India, arranged according to the modern system of classification; with brief notes on their habits and geographical distribution, and description of new, doubtful and imperfectly described species. *Madras Journal of Literature and Science 10(25)*: 234–269.

Kazmierczak, K. (2000): A Field Guide to the Birds of India, Sri Lanka, Pakistan, Nepal, Bhutan, Bangladesh and the Maldives. Om Book Service, New Delhi. Pp. 232.

Oates, E.W. & W.T. Blanford (1889): The Fauna of British India including Ceylon and Burma. Birds. Volume 1. Taylor and Francis, London. Pp. 97–100.

Praveen, J. & P.O. Nameer (2009): Monitoring bird diversity in Western Ghats of Kerala. *Current Science 96(10)*: 1390–1395.

Rasmussen, P.C. & J.C. Anderton (2005): Birds of South Asia – The Ripley Guide. Smithsonian Institution and Lynx Edicions. Washington, D.C. and Barcelona. Pp. 414–415.

Robin, V.V., A. Sinha & U. Ramakrishnan (2010): Ancient Geographical Gaps and Paleo-Climate Shape: the Phylogeography of an Endemic Bird in the Sky Islands of Southern India. *PLoS ONE 5(10)*: e13321.

Sashikumar, C., J. Praveen, M.J. Palot & P.O. Nameer (2011): Birds of Kerala: status and distribution. DC Books, Kottayam. Pp. 590–593.

Tobias, J.A., N. Seddon, C.N. Spottiswoode, J.D. Pilgrim, L.D.C. Fishpool & N.J. Collar (2010): Quantitative criteria for species delimitation. *Ibis 152(4)*: 724–746.

Zarri, A.A., A.R. Rahmani, A. Singh & S.P.S. Kushwaha (2008): Habitat suitability assessment for the endangered Nilgiri Laughingthrush: A multiple logistic regression approach. *Current Science 94(11)*: 1487–1494.

■ ■ ■